Elliptic Flow of Multistrange Baryons Ξ and Ω in Au + AuCollisions at $\sqrt{s_{NN}}$=200 GeV

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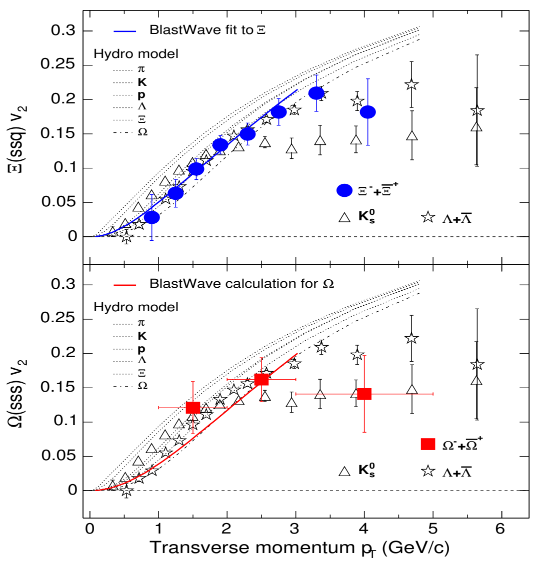

FIG. 1: The Ξ^-+ $\overline{\Xi}^+$(top) and Ω^-+ $\overline{\Omega}^+$(bottom) $v_2(p_T)$ from 200 GeV Au + Au minimum bias collisions. The v_2 of $K^0_s$and Λ [3] are shown also shown. Hydrodynamic model predictions [6] are shown as dashed lines for π, K, p, Λ, Ξ^-, and Ω^-, from top to bottom. The result of the hydro-inspired model fit is shown as solid lines.

Multistrange baryons have been suggested to be sensitive to the early stage of the system created in ultra-relativistic heavy ion collisions [1] due to their predicted low hadronic cross sections [2]. Elliptic flow, due to its self quenching nature, has also proven to be a good tool for understanding the properties of the early stage of the collision. Thus multistrange baryon elliptic flow could be a valuable probe of the initial partonic system.

Using the STAR detector at RHIC, Ξ and Ω are reconstructed via their decay topology $\Xi \rightarrow \Lambda + \pi$ and $\Omega \rightarrow \Lambda + K$ followed by $\Lambda \rightarrow p + \pi$. Cuts on geometry, kinematics and particle identification via specific ionization are applied to reduce the combinatorial background. This yields to a peak (S) of Ξ (Ω) over a remaining background (N) in their invariant mass distribution with $S/N \sim 1$. The background is determined by sampling two regions on either side of the peak, or by rotating the Λ candidates by 180° and then reconstructing Ξ and Ω candidates. We calculate the elliptic flow parameter v_2 from the distribution of the particle raw yields as a function of the azimuthal angle with respect to the reaction plane.

Figure 1 shows the v_2 for K^0_S, Λ [3] for multi-strange baryons Ξ^-+$\overline{\Xi}^+$(top) and Ω^-+$\overline{\Omega}^+$(bottom) vs. p_T for the minimum bias data set. First, the v_2 for Ω is clearly non-zero, indicating that even the triply-strange baryon Ω shows significant elliptic flow. Second, the p_T dependence of the v_2 for Ξ is comparable to that of the single-strange Λ baryon. This supports the previously suggested baryon to meson dependence of the v_2 [3], and indicates it is not a particle mass effect. This is also consistent withe the universal scaling of v_2 and the hadron p_T with the number of constituent quarks (n), predicted by the by quark coalescence or recombination models [4, 5] with the underlying assumption of collectivity among partons. Furthermore, the similarity of v_2 for $\Lambda(uds)$, $\Xi(dss)$ and $\Omega(sss)$ supports the idea that the partonic flow of s quarks is similar to that of u,d quarks.

In an extended [7] hydro-inspired model [8] all considered particles are emitted from a thermal expanding source with a transverse flow rapidity ρ, at the thermal freeze-out temperature T_{fo}. Furthermore, ρ is asymmetric with respect to the reaction plane ($\rho = \rho_0 + \rho_a \cos(2\phi)$), and the spatial asymmetry of the source at thermal freeze-out is described by the eccentricity $\varepsilon = \frac{R_y^2 - R_x^2}{R_y^2 + R_x^2}$ where R_x and R_y are the radii in the in-plane and out-of-plane directions respectively. A simultaneous fit to the p_T spectra and the $v_2(p_T)$ of $\Xi^-$and $\overline{\Xi}^+$results in $T_{\text{fo}} = 142 \pm 17$ MeV, $\rho_0 = 0.80 \pm 0.05$, $\rho_a = 0.047 \pm 0.017$ and $\varepsilon = 0.17 \pm 0.05$. The resulting $v_2(p_T)$ is shown in Fig. 1 for (a) Ξ and (b) Ω as the solid lines. As previously observed [1], the Ξ data is best described with high T_{fo} and low ρ_0. Also, the $v_2(p_T)$ for Ξ seems to favor an out-of-plane extended source at thermal freeze-out ($\varepsilon > 0$). The azimuthally sensitive π HBT results in $\varepsilon \sim 0.13$ for a similar centrality [9], and a fit to the PHENIX π, K and p spectra and v_2 results in $\varepsilon = 0.121 \pm 0.004$ [10].

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